# Obsolescence Management for Materials and Processes

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2011 International Workshop on Environment and Alternative Energy
ESTEC, Noordwijk
15 Nov 2011

# Agenda

1. Management of obsolescence of materials and processes
2. The REACH authorisation process
3. Technical risk assessment
4. Identified risks from REACH
    a. Annex XIV
    b. Annex XIV recommendations
    c. Candidate list
    d. REACH/CLP
5. Conclusions

# Materials & Processes Obsolescence

## Potential causes

### Legislative reasons

- Environmentally driven regulations, e.g. REACH, RoHS
- Export restrictions, e.g. ITAR

### Technical and market evolution

- Production shortfalls or stops
- Large volume consumer market moves ahead and space industrial niche market remains only user

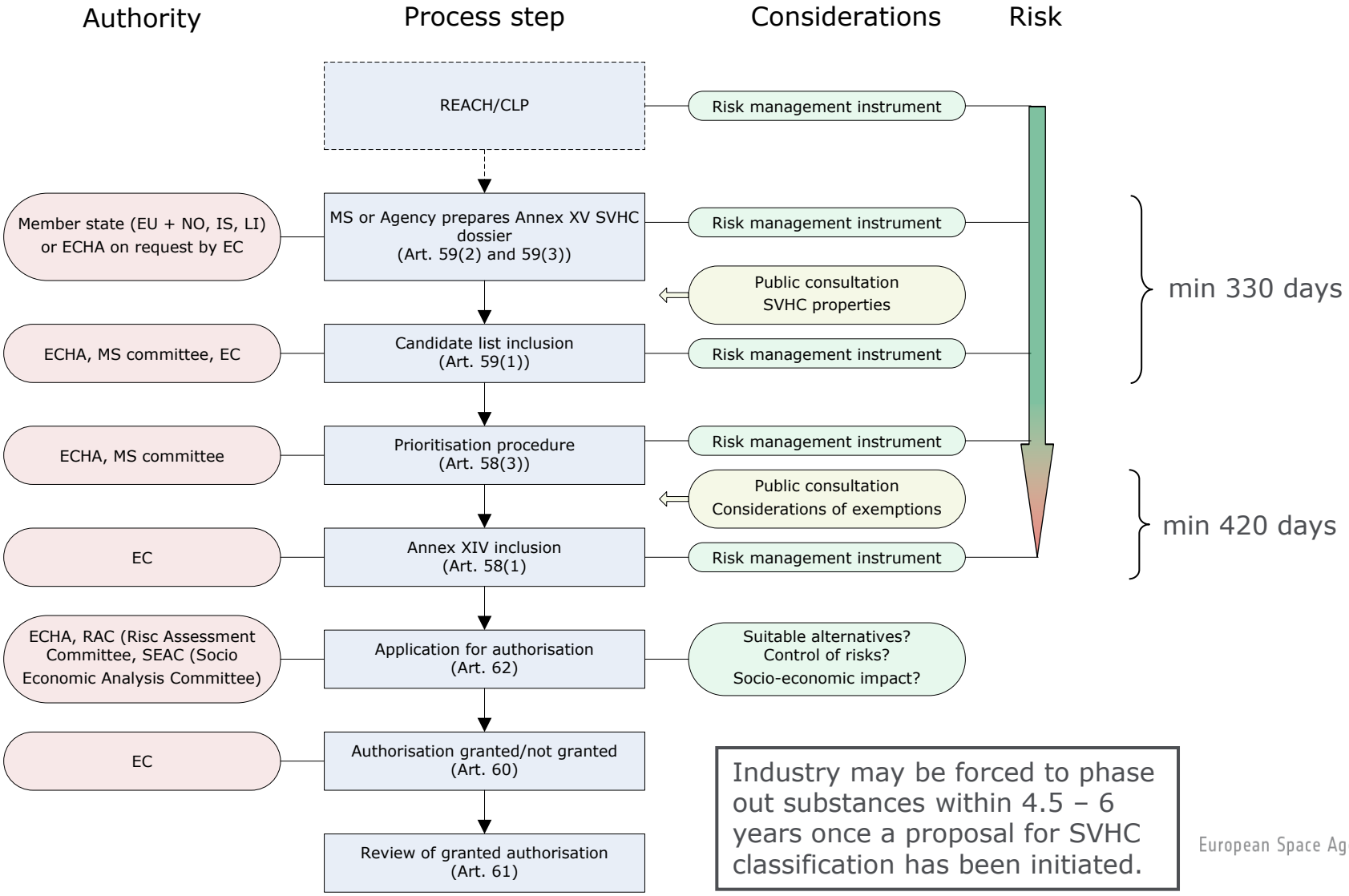
## Consequences

- Disappearance of products from European market
- Change in materials composition
- Change in manufacturing processes

## Effects on European space programs

- Space validation of alternative materials and processes
- Costly new product and process developments
- Impact on project schedules, launch delays

# The REACH authorisation process




Industry may be forced to phase out substances within 4.5 – 6 years once a proposal for SVHC classification has been initiated.

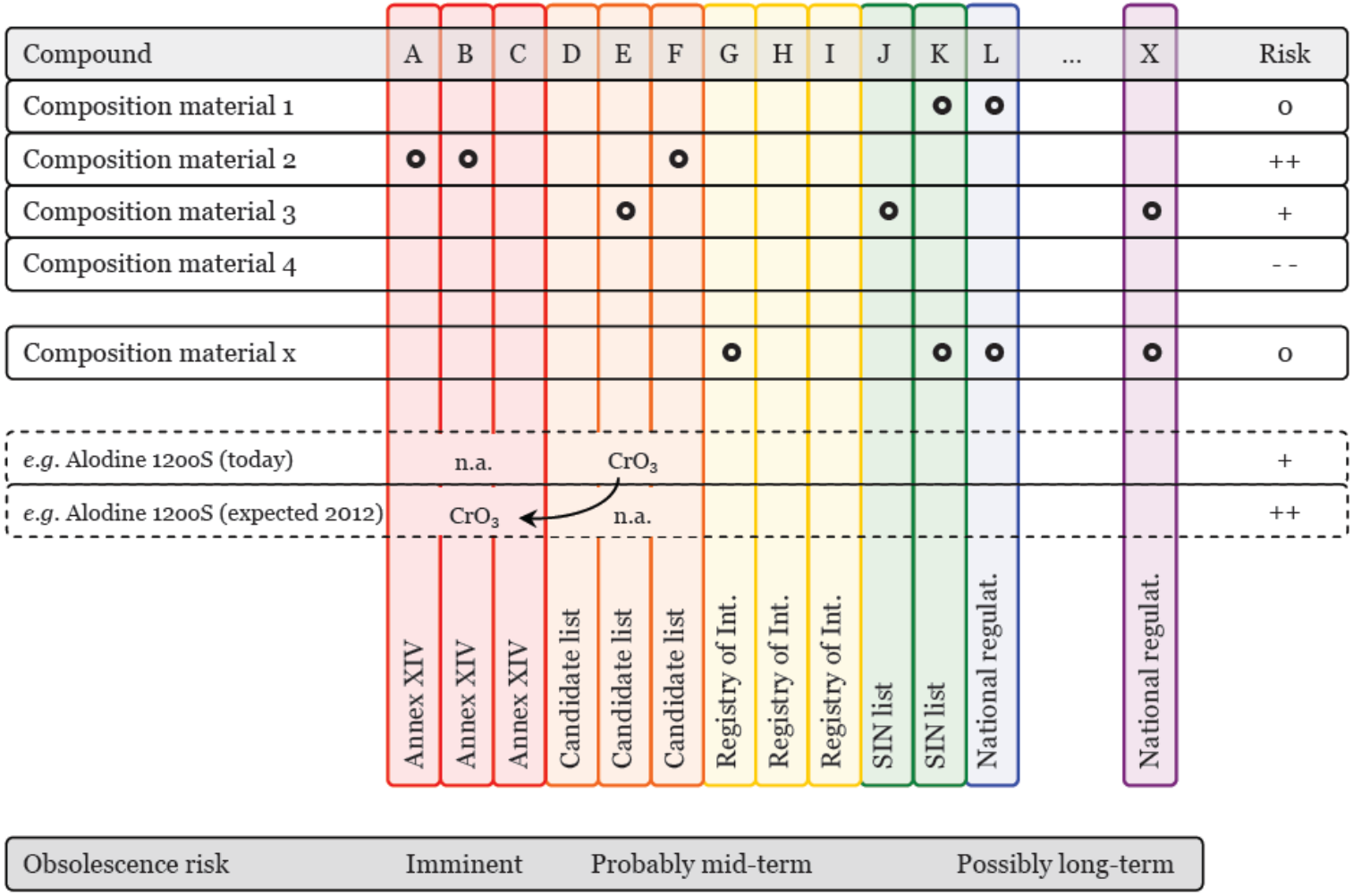
# Managing the obsolescence risk

Observatory group on a European-wide platform has been established involving, national space agencies, industry, and ESA with the objectives to:

- Identify in advance potential critical materials and processes for satellite platforms and launchers.
- Reduce programmatic risks and costs by early replacement, including use of alternatives, re-qualification or possibly new developments.
- Perform a risk assessment of identified materials and processes taking into account the status of environmental regulation, diversity of uses, availability of alternatives, *etc.*
- Propose corrective actions that may include
  - Use of already qualified or qualification of alternatives
  - Development of alternatives
  - REACH authorisation for space-related applications
  - REACH exemption for space industry (if legally applicable)

**Main risks currently related to REACH regulation.**

# Materials cross-check



# Risk assessment

| Cross-check of materials is being performed with | Obsolescence risk |
|---|---|
| • Annex XIV | imminent |
| • Candidate list | mid-term |
| • Registry of Intentions | mid-term |
| • CLP, SIN-list [1] | long-term |
| • Gap analysis – non registered substances | investigate |

→ Inventory of affected materials/substances, currently about 1500 database entries

The risk is weighed according to

- Spectrum of different applications and users
- Annual volume applied by industry
- Availability of alternatives
- Resources required for qualification of alternatives
- Strategic value for space applications

→ Mitigate risk accordingly (alternatives, authorisation, exemption)

[1] The SIN list (www.sinlist.org) is an NGO driven project to speed up the transition to a toxic free world. List 2.0 consists of 378 chemicals that are identified as SVHC based on the criteria established by REACH.

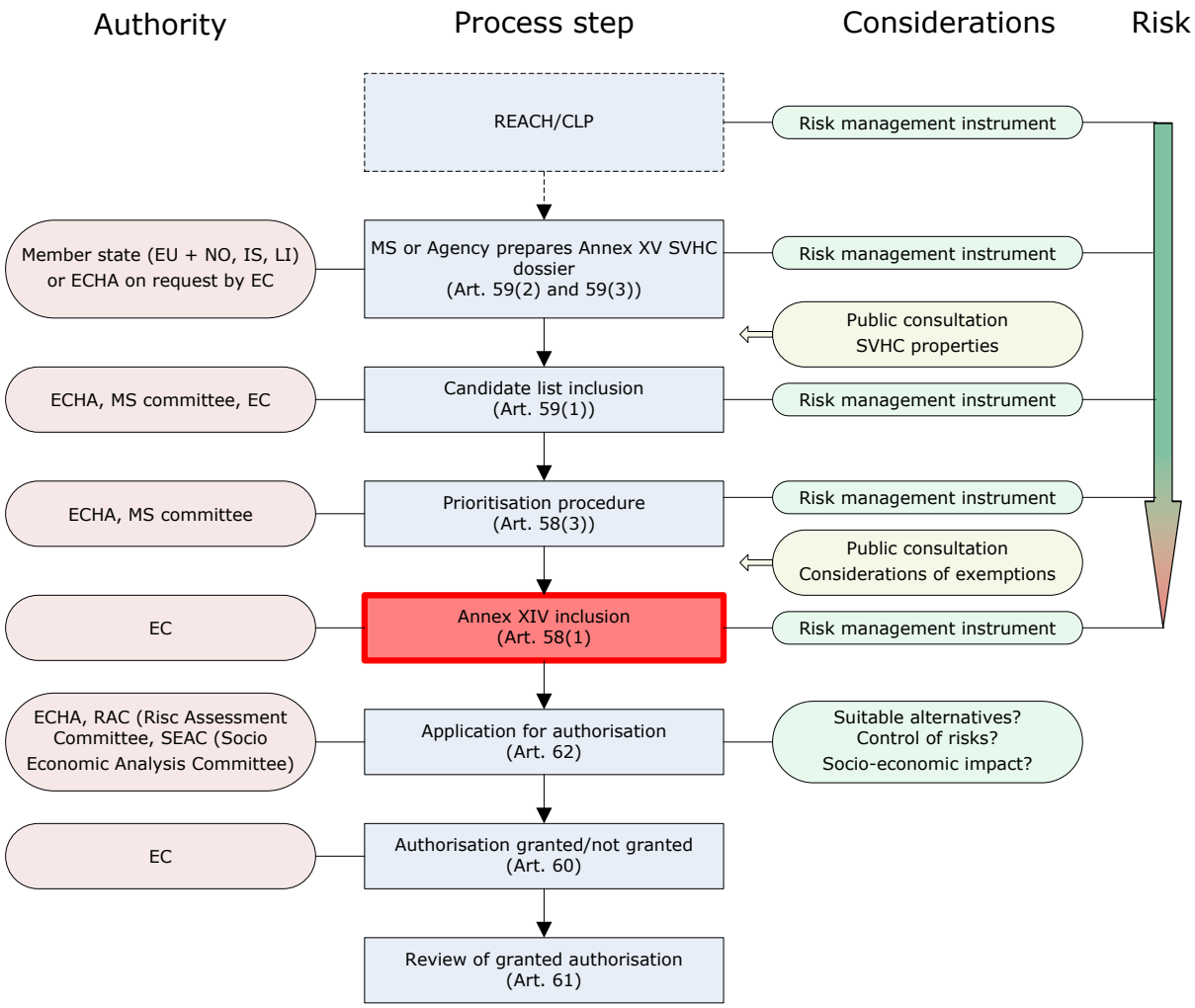
# Status of authorisation process

| | | | | | |
|---|---|---|---|---|---|
| Trichloroethylene (draft) | 2,4-Dinitrotoluene (2,4-DNT) (17.12.10) | Diisobutyl phthalate (DIBP) (17.12.10) | 5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene) (21.2.11) | Diarsenic trioxide (17.12.10) | Cobalt(II) carbonate (draft) |
| Boric acid | Acrylamide | Lead chromate (17.12.10) | Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins) | Dibutyl phthalate (DBP) (21.2.11) | Cobalt(II) diacetate (draft) |
| Disodium tetraborate, anhydrous | Aluminosilicate Refractory Ceramic Fibres | Lead chromate molybdate sulphate red (C.I. Pigment Red 104) (17.12.10) | Anthracene | Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (21.2.11) | 2-Methoxyethanol |
| Tetraboron disodium heptaoxide, hydrate | Anthracene oil | Lead sulfochromate yellow (C.I. Pigment Yellow 34) (17.12.10) | Benzyl butyl phthalate (BBP) (21.2.11.) | Lead hydrogen arsenate | 2-Ethoxyethanol |
| Potassium dichromate (draft) | Anthracene oil, anthracene-low | Pitch, coal tar, high temp. | Bis (2-ethylhexyl)phthalate (DEHP) (21.2.11) | Sodium dichromate (draft) | Chromium trioxide (draft) |
| Ammonium dichromate (draft) | Anthracene oil, anthracene paste | Tris(2-chloroethyl)phosphate (TCEP) (17.12.10) | Bis(tributyltin)oxide (TBTO) | Triethyl arsenate | (draft) Chromic acid, Oligomers of chromic acid and dichromic acid, Dichromic acid |
| Potassium chromate (draft) | Anthracene oil, anthracene paste, anthracene fraction | Zirconia Aluminosilicate Refractory Ceramic Fibres | Cobalt dichloride (draft) | Cobalt(II) sulphate (draft) | 2-ethoxyethylacetate (added 20.6.11) |
| Sodium chromate (draft) | Anthracene oil, anthracene paste,distn. lights | 4,4'-Diaminodiphenylmethane (MDA) (21.2.11) | Diarsenic pentaoxide (17.12.10) | Cobalt(II) dinitrate (draft) | strontium chromate (added 20.6.11) |
| 1,2-benzenedicarboxylic acid, di-C7-11 branched and linear alkyl esters (DHNUP) | hydrazine (added 20.6.11) | 1-methyl-2-pyrrolidone (added 20.6.11) | 1,2,3-trichloropropane (added 20.6.11) | 1,2-benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DIHP) (added 20.6.11) | |

| |
|---|
| (only) included on Candidate List |
| recommended for Annex XIV inclusion |
| (already) included in Annex XIV |

Source: REACHLaw

# Status of Annex XIV (authorisation list)



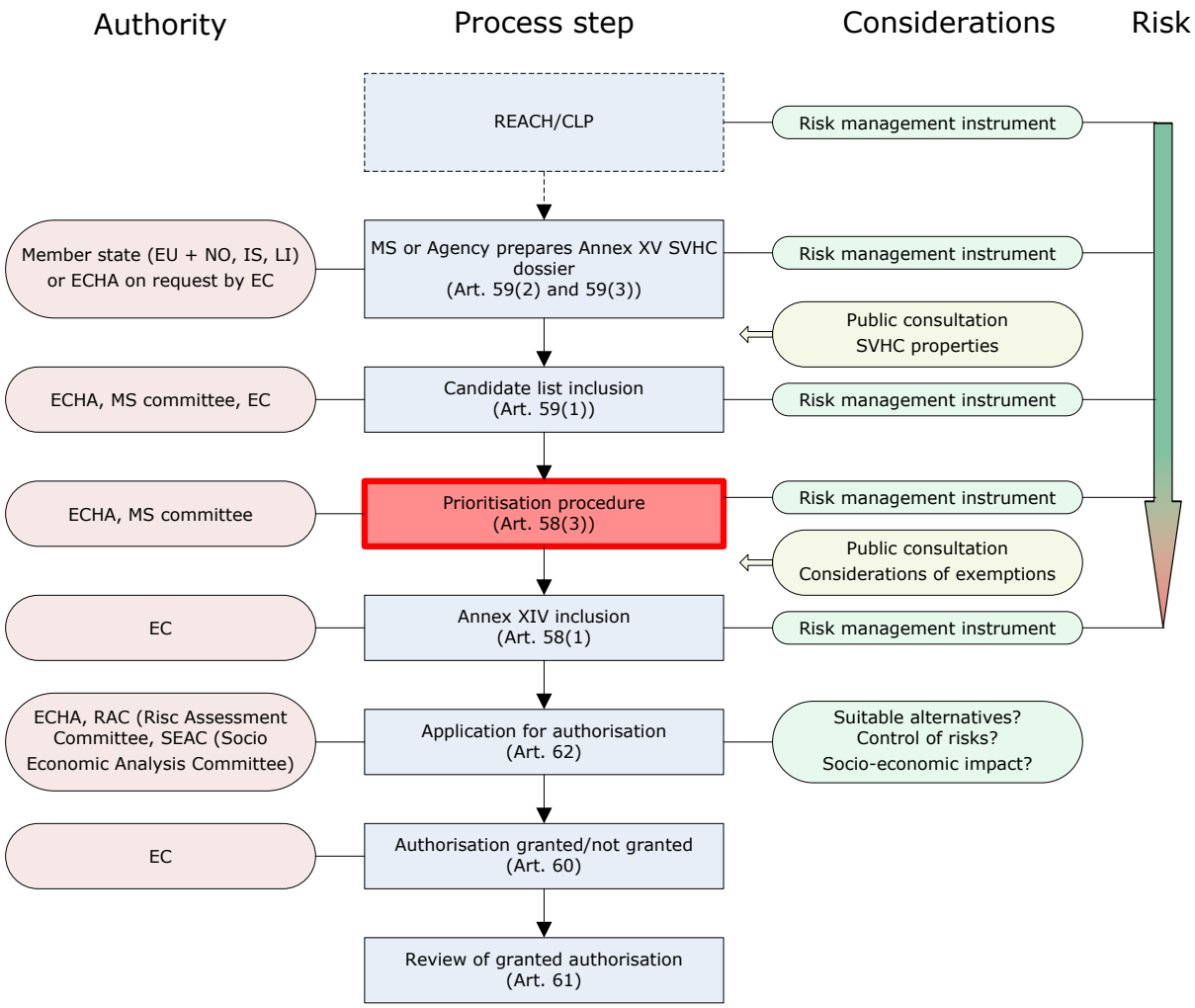
# Status of Annex XIV (authorisation list)

| Substance | Intrinsic properties | Latest application date | Sunset date |
|---|---|---|---|
| 5-tert-butyl-2,4,6-trinitro-m-xylene **(Musk xylene)** | vPvB | 21.2.2013 | **21.8.2014** |
| 4,4'-Diaminodiphenylmethane **(MDA)** | Carc 1B | 21.2.2013 | **21.8.2014** |
| Hexabromocyclododecane **(HBCDD)** | PBT | 21.2.2014 | **21.8.2015** |
| Bis(2-ethylhexyl) phthalate **(DEHP)** | Repr 1B | 21.8.2013 | **21.2.2015** |
| Benzyl butyl phthalate **(BBP)** | Repr 1B | 21.8.2013 | **21.2.2015** |
| Dibutyl phthalate **(DBP)** | Repr 1B | 21.8.2013 | **21.2.2015** |

Very little appearance of MDA or phthalates in space applied materials, applications are non-critical

→ Currently no associated action

# Current Annex XIV recommendations



# Annex XIV recommendations
# Status of Cr(VI) compounds

| Substance | Candidate List | Draft Rec. | Final Rec. | Annex XIV (Sunset Date) |
|---|---|---|---|---|
| **Sodium dichromate** | 28.10.2008 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **Potassium Dichromate** | 18.6.2010 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **Ammonium Dichromate** | 18.6.2010 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **Sodium Chromate** | 18.6.2010 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **Chromium Trioxide** | 15.12.2010 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **(Di)chromic acid and its oligomers** | 15.12.2010 | **15.6.2011** | *Late 2011?* | *Earliest end 2012 (2016)* |
| **Strontium Chromate** | **20.6.2011** | *4th? (June 2012)* | *Earliest end 2012* | *Earliest 2014 (2017)* |

Source: REACHLaw

# Applications of Cr(VI) compounds

Examples of Cr(VI) applications cover:

- Chromic conversion coating

  Corrosion protection for Al and Mg alloys, e.g. Alodine 1200S ($CrO_3$)
- Primers

  Corrosion inhibition, adhesion promotion, e.g. structural primer BR 127 ($SrCrO_4$)
- Greases

  Corrosion inhibition ($Na_2CrO_4$)
- Chromic acid anodisation

  Corrosion protection, thermal control ($CrO_3$)
- Sealing after chromic acid anodisation

  Improvement of corrosion protection ($K_2Cr_2O_7$)
- *etc.*

Need qualified replacements before reaching the sunset date 2016/17, possibly earlier. Various commercial solutions are available → Qualification programs

# Current qualification programs

Intention to bring qualification programs on European/international platform to

- Avoid duplication, safe resources
- Give industry access to test data

Replacement for primer BR 127: Currently driven by industry

Replacement for Alodine 1200S: Several interlinked test programs, one by NASA/ESA

**NASA/ESA test campaign for Alodine 1200S replacement**

Challenges:

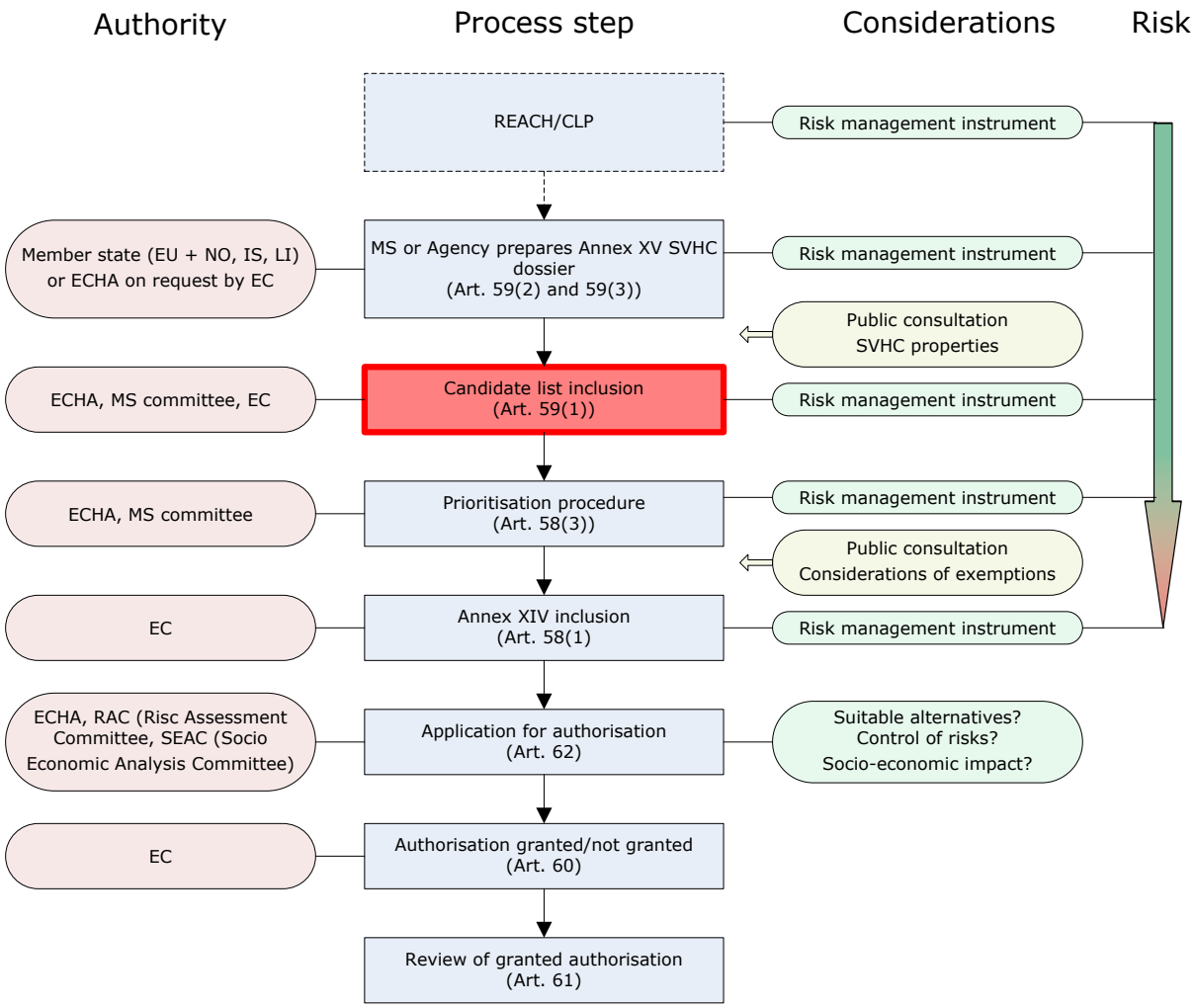
- Many commercial solutions available, not as universal as Alodine 1200S
- So far Alodine 1200S serves as reference system
- Experience shows that none of the Cr(VI)-free systems reach same performance

→ Cr(VI) conversion coating remains the reference system

→ Need possibly to revisit performance requirements

→ Include standard 'rough' test environment (salt spray) and 'mild' test environment (moist heat) – introduced by EADS Astrium

# Status of candidate list



# Example: Hydrazine

- Classified carc 1B, on candidate list since 20.6.2011
- Expect Annex XIV inclusion (earliest) 2012, sunset date possibly 2015
- Monopropellant for attitude control of launchers and satellites
- Produce thrust by catalytic decomposition ($N_2H_4 \rightarrow N_2$, $NH_3$, $H_2$)
- High purity grade (~ 99%)
- Several steps/uses
  - Import/manufacture low/high grade hydrazine. Currently most hydrazine imported from US and China
  - Purification
  - Distribution/transport
  - Ground testing
  - Loading, off-loading, waste disposal
  - In-orbit firing
- Very well controlled procedures to exclude human/environmental exposure
- No viable alternative is available yet
- Green alternative: ADN, technology demonstration on PRISMA satellite

# Hydrazine – Exemption/Authorisation

**Strategic technology**

- Access to space, earth observation, science, exploration, defence (Galileo), telecommunication, *etc.*
- Commercial space sector vs. ESA roughly 50:50

**Authorisation**

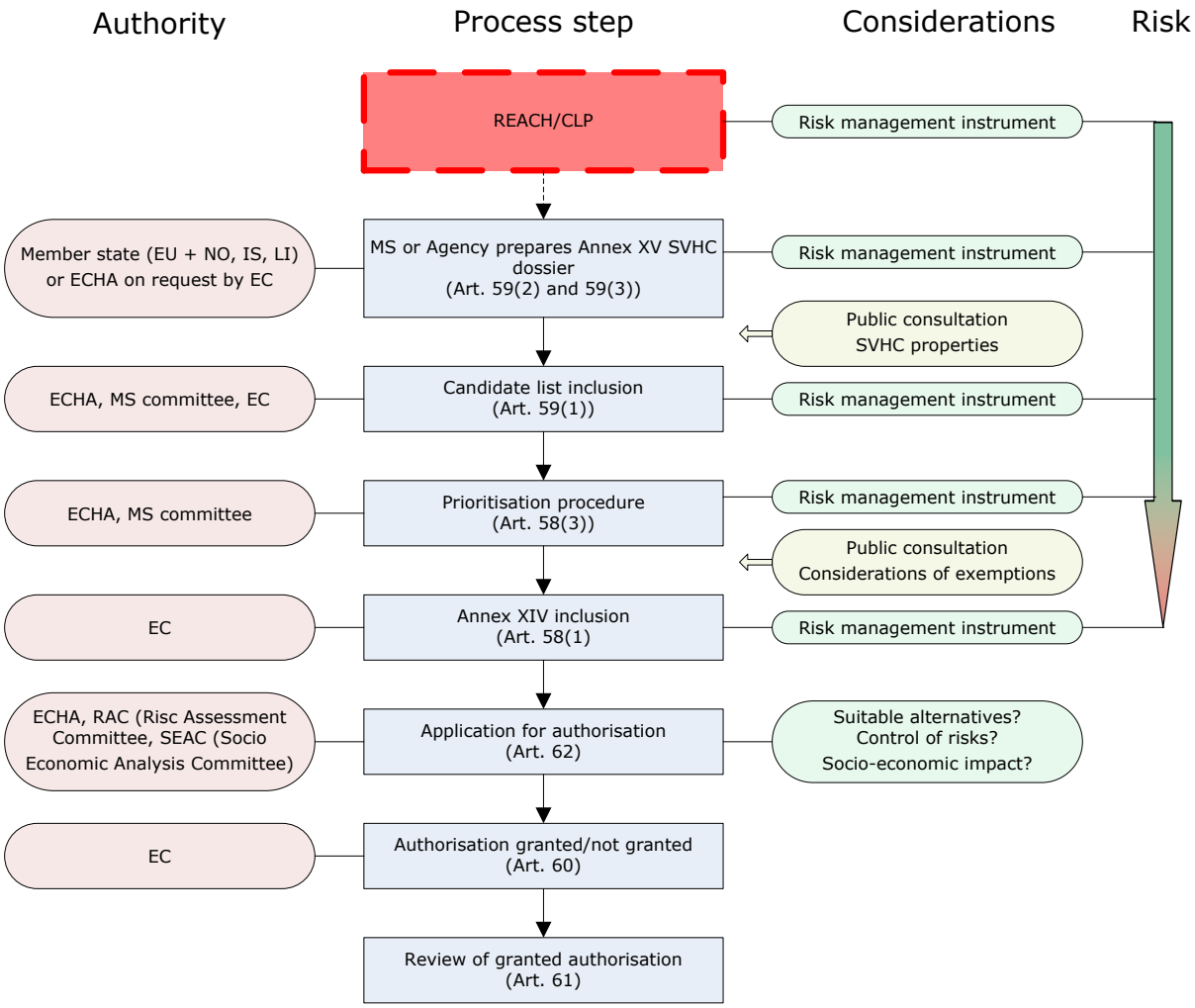
- Very controlled and safe use/handling of propellants and
- Socio-economic impact

**Exemption**

- On-site isolated and transported isolated intermediates
- In scientific research and development
- As fuel in mobile or fixed combustion plants of mineral oil products and use as fuels in closed systems
- *Etc.*
- Is it realistic? → Mapping of all space uses and exemption study ongoing

Rely on hydrazine even in long-term (performance and cost competitiveness), REACH may create the right incentives to pursue alternative solutions.

# Status of REACH/CLP



# Status of REACH/CLP

CLP or CLP Regulation is the new European Regulation on **C**lassification, **L**abelling and **P**ackaging of chemical substances and mixtures. It identifies:

- Potential Substance of Very High Concern (SVHC) → Authorisation (Annex XIV)
- Potential substance posing 'unacceptable risk' → Restriction (Annex XVII)

The European Commission is currently working on the Third Adaptation to Technical Progress (3rd ATP) of CLP, leading to an updated Annex VI.

Among others, the following substances are under considerations:

- Chloroform (carc. 2, repr. 2)
- Gallium arsenide (carc. 2/1A, repr. 1B see next slide)
- Indium phosphide (carc. 1B, repr. 2)

Identification as SVHC requires CMR 1A/1B, PBT, vPvB

Harmonized CMR classification may lead directly or indirectly future approval of the substance (authorisation & restrictions) → industry should be active already at this stage

# Current REACH/CLP status - examples

**Chloroform (cleaning process)**

Proposed CMR classification 'only' 2, but also difficulties of use in some EU member states. Used in ECSS-Q-ST-70-05C 'Detection of organic contamination of surfaces by infrared spectroscopy' → Replacement currently investigated

**Gallium arsenide (RF EEE components, solar cells)**

2.6.2009: Draft dossier for classification carc 2, repr 1B by France

25.5.2010: RAC opinion of GaAs classification is carc 1A, repr 1B

11.3.2011: Re-opening of GaAs carc classification carc 1A, deadline 25.4.2011

8-10.6.2011: 8th meeting of competent authorities for REACH and CLP

The 3rd Adaptation to Technical Progress is working to update the CLP Annexes for harmonisation of classification. There has been a delay in publishing the 3rd ATP due to a couple of problematic substances, and some have suggested removing the substances and publishing the ATP while the Commission decides upon the proper scientific procedures. The UK suggested that 2 'problem substances', gallium arsenide and epoxiconazole, be removed from the 3rd ATP to allow progress on the other 17 substances of this ATP.

→ GaAs will not yet be included in the candidate list

# Conclusions

- Progressive reduction of availability of materials and processes is expected, main issues currently driven by REACH
- Active obsolescence risk management required (European observatory)
  - Long-term view
  - Risk matrix
- Examples of substances identified that are relevant for space applications
  - Chromates
  - Hydrazine
  - Gallium arsenide
  - Solvents such as chloroform
- Corrective actions for risk mitigation
  - Active involvement in public consultations
  - Joint qualification of alternatives (European, international stakeholders)
  - Collaborative application for authorisation and possibly exemption